Technical Research Note 228

AD

EFFECTS OF GENERAL ABILITY, EDUCATION, AND RACIAL GROUP ON APTITUDE TEST PERFORMANCE

Milton H. Maier

MILITARY SELECTION RESEARCH DIVISION

BESRL

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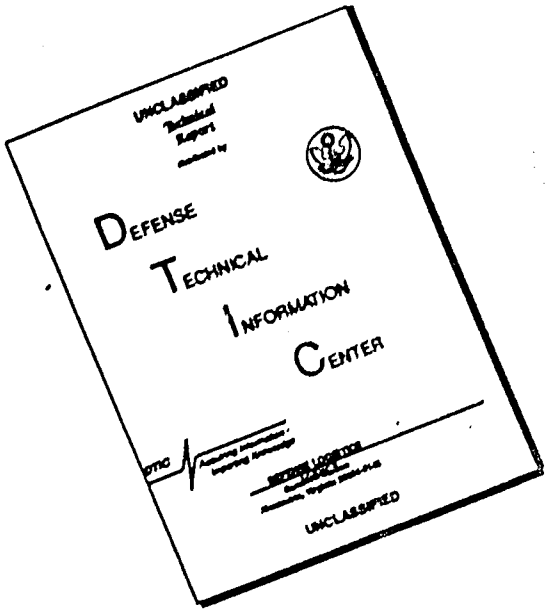

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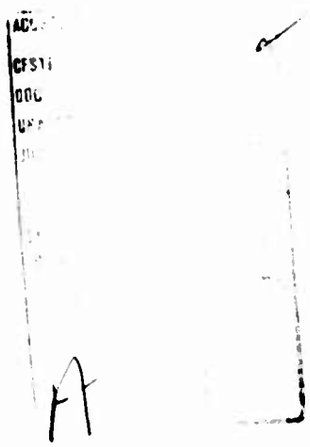

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13 ABSTRACT

The DIFFERENTIAL CLASSIFICATION Work Unit, BESRL is concerned with application of psychological measurement methods to enable the Army to best utilize the different skills and aptitudes of its enlisted personnel. The present publication reports on an examination of the relationship among the Army Classification Battery tests in various subgroups of the Army enlisted input consisting of men of different levels of mental ability, different educational levels, and Negroes and whites for possible differences for variant subgroups. Data obtained on more than 1[illegible] men enlisting in January 1[illegible] were statistically treated to yield evidence on appropriateness of the ACB for groups categorized by socially significant variables. The three characteristics selected for study, on basis of AFQT score, were general mental ability, level of education, and racial group. From data available in official Army records, the men were categorized as non-high school graduates and high school graduates. The racial identifications in the present study, Negro and white, were determined by self-reports and indicated the social category in which the person placed himself and in which he was placed by his peers.

Intercorrelation matrices of scores on the ACB measures were computed for each category and together with means and standard deviations were compared to determine similarities and differences among the subgroups. Also presented is a second set of values for subgroups equated for variability on AFQT. Results obtained demonstrate the difficulty of drawing accurate conclusions about effectiveness of aptitude tests for minority groups. One result remained invariant -- the emergence of the academic and mechanical clusters of tests for all subgroups. It was found that the specific content

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13. ABSTRACT continued

of the tests rather than their verbal-nonverbal character is critical to the contribution each test makes to the clusters of aptitudes. There were enough differences among tests and groups to warrant an extensive research program to find out what differences exist and to determine what impact these have on the Army's selection-classification-training-utilization system.

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FOREWORD

The DIFFERENTIAL CLASSIFICATION Work Unit applies psychological measurement methods to enable the Army to make best use of the different skills and aptitudes of its enlisted personnel through increasingly accurate and differentiated measures of individual potential. Research is conducted to maintain and improve the effectiveness of the Army Classification Battery and related techniques and of conditions which may interact with the classification tests and thus affect the basis for utilization of the enlisted input--changes in training programs and job content and environment, for example.

The entire research task is responsive to special requirements of the Deputy Chief of Staff for Personnel and the U. S. Continental Army Command, as well as to objectives of RDT&E Project 2Q062106A722, "Selection and Behavioral Evaluation," FY 1971 Work Program.

The present publication reports on an examination of the relationship among the tests of the Army Classification Battery in various subgroups of the Army enlisted population consisting of men of different levels of mental ability, different educational levels, and whites and Negroes for possible differences for different subgroups.

J. E. UHLANER, Director
Behavior and Systems
Research Laboratory

EFFECTS OF GENERAL ABILITY, EDUCATION, AND RACIAL GROUP ON APTITUDE TEST PERFORMANCE

BRIEF

Requirement:

To determine whether the tests of the Army Classification Battery (ACB) measure the same aptitudes for all significant subgroups of the Army enlisted population.

Procedure:

Data were obtained on over 17,500 men who entered the Army in January 1968. The sample was classified on the basis of AFQT score into three levels of general ability, as high school graduates and non-high school graduates, and as Negro and white. Intercorrelation matrices of scores on the ACB measures were computed for each category. These, with means and standard deviations, were compared to determine similarities and differences among the subgroups. Uncorrected standard deviations and correlation coefficients for the sample are presented as well as a second set of values for the subgroups equated for variability on AFQT.

Findings:

The ACB tests appear to be measuring the same clusters of aptitudes--academic and mechanical--for all the subgroups. The specific content of the tests rather than their verbal-nonverbal character is critical to the contribution each test makes to the clusters of aptitudes.

Utilization of Findings:

The present analysis is the first stage in an extensive research program to establish the usefulness of the ACB with significant subgroups of the enlisted population. Subsequent research will deal with the relationship of ACB tests to training and job performance.

EFFECTS OF GENERAL ABILITY, EDUCATION, AND RACIAL GROUP ON APTITUDE TEST PERFORMANCE

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EFFECTS OF GENERAL ABILITY, EDUCATION, AND RACIAL GROUP ON APTITUDE TEST PERFORMANCE

BACKGROUND

The Army Classification Battery (ACB) scores have for over twenty years aided Army personnel managers in making intelligent decisions about the differential classification and placement of Army recruits. Beyond question, the operation of such a large personnel system would be extremely difficult without the information provided by the tests about each man's capabilities. The ACB test scores are of known accuracy in measuring the potential of individuals entering the system. In recent years, however, questions have been raised about the appropriateness of the tests for certain elements of the population.

To capitalize on any differences in the effectiveness of tests that may exist among subpopulations the moderator theory was developed (1,2,3). Separate predictor scores, and sometimes even different sets of tests, may be used with may be used with males and females, for example. Another development is an emerging social concern over the appropriateness of the usual type of paper-and-pencil tests for members of disadvantaged groups; the court decision by Judge Wright (4) on the effects of the track system in the schools was based in part on question as to the appropriateness of so-called intelligence tests for Negro school children.

The theory and techniques of differential classification and prediction which underlie the development and use of the ACB were largely developed by Brogden (5,6). In differential prediction, separate regression equations are developed for each criterion that can be reliably distinguished. Each criterion places a particular combination of demands

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[1] Saunders, D.R. Moderator variables in prediction. Educational and Psychological Measurement. 1956, 16, 209-222.

[2] Johnson, C.D. The population control or moderator variable in personnel research. Proceedings, Tri-Service Conference in Selection Research, Office Naval Research. May, 1960.

[3] Lord, F.M. and M.R. Novick. Statistical theories and mental test scores. Reading, Mass: Addison Wesley, 1968.

[4] Wright, J.S. Hobson vs Hansen, Washington, D. C. Congressional Record. June 21, 1967.

[5] Brogden, H.E. An approach to the problem of differential prediction. Psychometrika, 1946, 11, 139-154.

[6] Brogden, H.E. Least squares estimates and optimal classification. Psychometrika, 1955, 20, 249-252.

on the individual, and thus requires a unique profile of aptitudes. In the Army personnel system, as generally in large personnel systems employing differential measurements, the same equations are assumed to apply to all segments of the input population, and the tests are further assumed to provide equally appropriate measures of these aptitudes for all persons.

Even though the Army has been using the ACB effectively for over twenty years and there is no reason to believe that the tests are not appropriate for the entire input population, no research evidence is available to demonstrate conclusively that the tests measure the same things for all subgroups. The present research was conducted to gather evidence on the appropriateness of the ACB for groups categorized by socially significant variables.

The three characteristics selected for study were general mental ability, level of education, and racial group. The average performance of individuals who score low on tests of general mental ability, or who have limited education (school dropouts), or who are Negro is usually found to be well below the mean for the general population. Further study of the effects of these characteristics is required to determine the extent to which the tests in the ACB are appropriate for individuals who are characterized by low mental ability or by a low level of education or by membership in the Negro racial group. The interaction of racial group with the other two characteristics is also of concern.

Two aspects of test effectiveness need to be considered: 1) criterion-related validity--the accuracy with which the test predicts performance in non-test situations such as in training or on the job, and 2) construct validity--the consistency of performance on tests designed to measure the same or similar attributes (7). Criterion-related validity is of special concern in an applied setting, such as the Army, where tests are used primarily for prediction. Consistency of measurement can help determine whether the tests are measuring the attributes they were designed to. For example, both verbal and quantitative skills are indicators of academic aptitude, and they should be substantially correlated except in highly restricted groups. It is reasonable to expect tests of these two attributes to be correlated in the Army population and in any large subgroups of it. Focus of the present analysis was on the construct validity of the ACB tests, when controls were exerted for general mental ability, level of education, and racial group. The accuracy of the tests in predicting performance in non-test situations will be covered in later reports.

Intercorrelations among the tests, although they do not necessarily indicate anything about the meaning of the tests in non-test situations, do show how stable and reasonable the relationships among the aptitudes are. Inferences can be drawn, for example, about the pervasiveness of a

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[7] French, J.W. and W.B. Michael (Eds). Standards for educational and psychological tests and manuals. Washington, D. C.: American Psychological Association, 1966.

general ability factor or about the relationship between academic and mechanical aptitudes, as well as about the meaning of nonverbal abilities.

METHOD

Sample

The total sample consisted of 1[illegible],72[illegible] enlisted men who entered the Army during January 19[illegible]. The sample was representative of the men coming into the Army during that time period in that it contained no known sources of bias. The results can probably be generalized to men who entered the Army during the late 19[illegible]'s.

Variables

The measure of general mental ability used to classify the men was the Armed Forces Qualification Test (AFQT). The AFQT, used as the selection instrument for the military services since 19[illegible], contains items on verbal ability, arithmetic reasoning, tool functions, and spatial ability. Half the items require reading ability (verbal and arithmetic reasoning); the other half are pictorial and require no reading. The AFQT was used to classify the sample into three levels of general ability: low, men who scored in the 10-30 percentile score range; average, those who scored in the 31-64 percentile score range; and high, those who scored at or above the 65 percentile rank. Persons who score below the 10 percentile rank are not qualified for Army service.

Data on level of education and racial group were obtained from official Army records. The men were categorized as non-high school graduates (0 to 11 years of education) and high school graduates (sucessful completion of 12th grade or higher). The racial groups were Negro and white. Race in the present study is a social variable rather than a biological or an anthropological one. Racial identification was determined by the self-report of the individual; it indicated the social category in which the person placed himself and in which he was placed by others.

The aptitude measures where those of the ACB. The tests are described in the tabulation on page 4. Since the ACB was introduced in 1940, numerous studies have been conducted to determine its effectiveness. The results have consistently shown that ACB tests and the aptitude areas based on them are accurate predictors of success in training and on the job (8,9).

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[a] Helme, W.H. Grouping Army training courses by Army Classification Battery factors. BESRL Technical Research Note 19[illegible], 19[illegible].

[b] Maier, M. H. and E. F. Fuchs. The development of improved aptitude area composites. BESRL Technical Research Report 11[illegible], 19[illegible].

TESTS IN THE ARMY CLASSIFICATION BATTERY
(All use multiple-choice responses)

1. Verbal Test(VE). [illegible] items. Each item requires the examinee to select the correct synonym for the underlined word in a short sentence.

2. Arithmetic Reasoning(AR). 4[illegible] items. Each item is a reasoning problem requiring selection and application of arithmetic processes.

3. Pattern Analysis(PA). [illegible]0 items. A two-dimensional pattern with numbered lines is presented along with the corresponding three-dimensional figure made by folding the pattern along the indicated lines. The examinee is required to identify the lettered edge of the figure corresponding to a numbered line in the pattern.

4. Mechanical Aptitude(MA). 4[illegible] items. Each item uses a picture to present a question based on some physical principle.

[illegible]. Army Clerical Speed(ACS). In Part I, Number Reversal ([illegible]0 items), the examinee indicates whether the second number in each item is exactly the reverse of the first. In Part II, Coding ([illegible]0 items), a key word is followed by a number that is associated with it. Each item presents a word followed by all numbers in the key. The examinee is to pick the number corresponding to the word in the key.

[illegible]. Army Radio Code(ARC). An auditory test, recorded on tape. The examinee is taught the code signals for three letters I, N, and T. Immediately after the learning exercises, a test of 1[illegible] items is given.

[illegible]. Shop Mechanics(SM). 4[illegible] items. Each item uses a drawing to present a question concerning some mechanical principle or tool usage.

8. Automotive Information(AI). 4[illegible] items. Each item is a question about the identification or operation of automobile parts.

[illegible]. Electronics Information(ELI). 4[illegible] items. The examinee is required to associate pictured objects in terms of how they function electronically, and to demonstrate in verbal items his knowledge of electronics principles.

10. Classification Inventory(CI). 1[illegible] items. Self-description items in which the examinee indicates his personal background, attitudes, self-evaluation, and experiences.

11. General Information Test (GIT). [illegible]0 items. Questions cover objective items of information about various avocational pursuits.

RESULTS

Intercorrelation matrices were computed for each group. These, along with means and standard deviations, were compared to determine the similarities and differences among the various groups. In the presentation of the results, the mean differences are discussed first and then the intercorrelations.

Two values of the standard deviations and correlations are presented for each set of figures: one set of values is the statistics as computed for the sample on hand; the second set shows the values that obtain when the groups are equated to have equal variability on the AFQT. The uncorrected standard deviations and correlation coefficients are descriptive of the men who entered the Army during January 1968. These uncorrected values cannot be compared across groups because the groups differ in variability. The initial differences were partially compensated for by statistically equating for variability of the groups on AFQT. Neither set of statistics by itself provides information that can be generalized to the entire population of young men of mobilization age, but the two together provide a more comprehensive description of the interrelationships among the control variables of racial group and level of education and the aptitude measures of the ACB.

Means and Standard Deviations

The population mean of the AFQT is 50 and the standard deviation 20.6. The sample had slightly lower values, a mean of 48.4 and standard deviation of 20.3. The population means of the ACB tests are 100 and the standard deviations 20, except for the Radio Code Aptitude Test which has a standard deviation of about 30. For this sample, the means for the Verbal, Clerical Speed, and Automotive Information tests were above 100, which is consistent with other observations in recent years. The means of the Classification Inventory and Army Radio Code Aptitude Test in this sample were 98.6 and 94.2, respectively, again consistent with recent findings. The standard deviations of the ACB tests fluctuated around the population values. The standard deviations for the Verbal and Arithmetic Reasoning tests were 20.7 and 21.0, respectively, once again consistent with recent samples. In general, the sample showed no peculiarities from other large samples observed during the same period. The means for the total sample and subgroups are presented in Appendix Table A-1.

The means for major groups were generally as expected. The men of lower ability, nongraduates, and Negro men scored lower on all the ACB tests. Not all tests showed the same degree of difference. The two tests with a strong academic orientation--Verbal and Arithmetic Reasoning--showed the greatest differences. The mechanical tests--Automotive Information, Shop Mechanics, and Electronics Information--tended to have smaller differences. The Army Clerical Speed Test, a nonverbal test, showed one of the smallest differences, but the other two nonverbal tests--Pattern Analysis and Radio Code--had large differences. The Classification Inventory, a noncognitive but still verbal test, had one

of the smaller differences. In general, the academically oriented tests had the largest mean differences, and the mechanically oriented tests the smallest. Verbal vs nonverbal content, per se, was not consistently related to the classification factors.

In the means for the race-by-education and race-by-general ability subgroups (shown in Table A-1), the confounding of ability and education with race was reduced. The same general pattern obtained in the subgroups as noted above for the major groups. The academic tests showed the largest differences and the Clerical Speed Test one of the smallest.

The race-by-education subgroups revealed a marked difference in the effect of educational level on test scores. For the white men, the differences between graduates and nongraduates were large, as would be expected. For the Negro men, however, the differences were small, and in some of the tests the nongraduates in fact scored higher than the graduates. The mean for white nongraduates was higher than for the Negro graduates on every test.

The mechanical tests had a different pattern of means for the education subgroups. The white nongraduates scored highest on Automotive Information (11.4) and Shop Mechanics (11.6), whereas the white graduates scored highest on the Verbal and Arithmetic Reasoning tests. These results are consistent with the folklore that the high school dropout has low academic achievement and interests but compensates by doing relatively well in the mechanical area. The Negro men did not show this same pattern. The Negro nongraduates did perform somewhat better on the mechanical tests than on the academic tests, but were well below the population mean on tests of both kinds. The Negro graduates scored about the same on both -- still below average.

The contrast between the Pattern Analysis and Clerical Speed Tests was especially striking in race-by-ability subgroups. The high-ability groups of both races scored relatively high on the Pattern Analysis Test and low on the Clerical Speed Test. At the low end of ability scale, both racial groups scored high on the Clerical Speed Test and low on the Pattern Analysis Test. The Clerical Speed Test consists of the simple perceptual tasks of determining whether the digits in a number have been reversed exactly and of finding the number that goes with a word. The Pattern Analysis Test presents a more difficult and less familiar task; the examinee must visualize the three-dimensional figure that results from folding a two-dimensional pattern. The high-level individuals were able to do well on these complex tasks, whereas the low-level individuals found them difficult. The simple tasks proved to be of more comparable difficulty throughout the ability range. The results indicated that more than verbal ability is involved in distinguishing between the high-and-low ability persons.

The AFQT and ACB standard deviations for the major groupings on general mental ability, level of education, and racial group are shown in Table A-2; the standard deviations as observed in the sample, termed the "observed standard deviations," are shown in the upper part of the

tables; the standard deviations equated on the basis of AFQT, termed "equated standard deviations," are shown in the lower part. The observed standard deviations were smaller for men of high mental ability, for nongraduates, and for Negro men. The equated standard deviations were more nearly equal, but there were some exceptions. The equated standard deviations on the Verbal, Arithmetic Reasoning, Clerical, and General Information tests were considerably higher for men of low ability than for men of high ability. On the tests with mechanical content, the equated standard deviations were more nearly equal.

The standard deviations of the subgroupings of race-by-mental ability and race-by-level of education are shown in Table A-[illegible]. In the race-by-education grouping, Negro men had lower observed standard deviations than did white men with the same level of education. Negro men of low ability also had smaller observed standard deviations; but for the men of average and high ability, the racial differences tended to disappear. The equated standard deviations showed some large fluctuations. Most notable were the high standard deviations for Negro men of low ability on the Verbal ([illegible]), the Arithmetic Reasoning ([illegible]), and the Pattern Analysis ([illegible]) tests. The equated standard deviations on the Verbal and Arithmetic Reasoning tests were also high for the Negro nongraduates and Negro graduates. The remainder of the equated standard deviations tended to be close to the population values.

The equated standard deviations indicated that by and large the AFQT served as a reasonable basis for equating the groups. The main exceptions were the academically oriented Verbal and Arithmetic Reasoning tests for the Negro men of lower ability. These high equated standard deviations revealed that other factors besides the AFQT were operating for the Negro men of low ability; the effects of the other factors was to increase the variability of the academic tests above that expected if AFQT were the only selection factor. In terms of the academic tests, the Negro men of low ability appeared to be from a different population than the other subgroups; but in terms of the mechanically oriented tests, they appeared to be part of the same population

Intercorrelation Patterns

Intercorrelation matrices were computed for the total sample, for each major group, and for each subgroup. The complete matrices as computed on the observed data are presented in Appendix B. Selected coefficients that bring out important relationships are reported below. Two sets of coefficients are included in each of Tables [illegible] through [illegible]: observed correlation coefficients based on variances and covariances as found in the sample are shown below the diagonal; coefficients based on equated AFQT variances are shown above the diagonal.[1]

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[1] With the exceptions of Tables [illegible], [illegible], and [illegible] in which a different arrangement is used.

Differences in standard deviations for the groups affect the magnitude of the coefficients, and thus the observed coefficients cannot be compared across groups. The equated coefficients are more nearly comparable, but the large equated standard deviations for the Negro men on the Verbal and Arithmetic Reasoning tests inflate the correlation coefficients for these tests.

The primary focus in looking for meaning in the intercorrelations was on the patterns of relationships, because the patterns are less affected by differences in variability than is the size of the coefficients. If the same patterns of relationships are found in both observed and equated matrices, then greater credence can be placed on the interpretations. The patterns are likely to reflect true differences among the groups rather than being merely statistical artifacts.

The intercorrelations for the total sample are presented first to provide the basis for interpreting the correlation coefficients for the groups; they are followed by the coefficients for the major grouping by general ability, education, and race, and finally by the coefficients for the cross-classifications of race by the other factors.

Intercorrelations in the Total Sample

All the correlation coefficients in the total sample were positive, and all the ACB tests were substantially correlated with AFQT, as shown in Table 1. Thus, there was a pervasive tendency for all the aptitude tests to cluster together. The lowest coefficients were between the ACS and ARC, the two perceptual tests, on the one hand, and SM, AI, and ELI on the other; these values ranged from .1[illegible] to .[illegible]. There was a tendency for two overlapping clusters of tests to emerge, an academic cluster consisting of VE, AR, GIT, PA, and MA, and a mechanical cluster consisting of AI, SM, ELI, MA, and GIT. But because of the high level of all correlation coefficients, the clusters were not sharply defined.

Effect of General Ability

When general mental ability was controlled, the two smaller clusters, academic and mechanical, emerged more clearly. The observed and equated coefficients within each cluster for each level of ability and for the total sample are shown in Table [illegible]. The academic cluster was defined by VE, AR, and GIT; the mechanical cluster was defined by GIT, MA, ELI, and AI. GIT was clearly in both. The observed intercorrelations tended to maintain a fairly constant level for the three ability groups, and the equated correlation in each group tended to be equal to the population values. Because of the differences that occurred in both the observed and equated standard deviations, the differences in the size of the coefficients across groups should be interpreted with considerable care.

In Table 2, the intercorrelation within each cluster was shown, and the tests were found to form homogeneous groupings. Another aspect of defining clusters is that they should be different from each other. The correlation between the academic and mechanical clusters is shown in Table 3. AI was the mechanical test most independent of the academic cluster, having observed coefficients of + .01 and .02 with VE and AR in the groups of high and average ability. MA and ELI were less clearly differentiated from the academic tests. Thus, the academic and mechanical clusters were differentiated, but the distinction was sharp only for the AI test.

The correlational pattern of PA with the other ACB tests was markedly different across ability levels; the results are shown in Table 4. For the total sample, PA had moderately high correlation with all tests; the observed coefficients ranged from .5[illegible] with AI and ACS to .57 with AR. When ability was controlled, PA had its highest observed and equated correlation coefficients in the high ability group. For the middle ability group the coefficients were lower, and for the low ability group the observed coefficients dropped to the zero range. The meaning of the tasks in the PA test appears to be different for the different ability levels. For the high group, PA was more of a general ability test; for the low group it was measuring an ability more independent of the other tests.

Effect of Education

The intercorrelations of the tests in the academic cluster and the mechanical cluster are shown in Table [illegible] for the high school graduates and nongraduates. The observed correlation coefficients in each cluster were uniformly higher for the graduates, while the equated values were more nearly comparable. The mechanical cluster appeared to be about as well defined for the nongraduates as for the graduates, especially when the equated values are considered.

Effect of Racial Group

Correlation among the academic tests and the mechanical tests is shown in Table [illegible] for Negro and white men. The same two test clusters, academic and mechanical, were found for both racial groups. The observed and equated correlation coefficients were about equal for the whites, but for the Negroes the equated values were much higher. The reason lies in the AFQT restriction; the Negroes as a group were more homogeneous on AFQT score, while the whites were distributed throughout almost the entire range. There is some suggestion that for the Negroes, whose mean ACB scores were lower, the mechanical cluster was not as well defined as for the whites.

Table 1

INTERCORRELATIONS[a] OF AFQT AND ACB IN THE TOTAL SAMPLE

	AFQT	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
AFQT		78[b]	79	44	52	69	68	61	53	61	75	39
VE	76[b]		75	46	53	70	58	52	40	43	56	40
AR	77	73		53	52	64	59	49	40	43	60	37
ACS	42	44	51		42	41	39	30	21	28	39	32
ARC	49	51	50	41		46	44	33	26	29	44	25
GIT	67	68	62	39	43		60	55	54	50	51	42
MA	65	56	56	36	42	57		59	56	60	58	37
ELI	58	49	46	28	30	53	53		57	55	48	32
AI	50	37	37	18	23	52	57	56		59	39	26
SM	59	40	40	25	26	47	57	53	57		52	33
PA	73	52	57	36	41	48	49	45	36	49		30
CI	37	38	35	30	23	40	35	30	24	31	28	

[a] Decimal points omitted.

[b] Observed correlation coefficients are shown below the diagonal, equated coefficients above the diagonal.

Table 2

INTERCORRELATIONS[a] WITHIN CLUSTERS OF ACB TESTS, GROUPED BY LEVEL OF MENTAL ABILITY

Group		Academic Cluster				Mechanical Cluster			
		VE	AR	GIT		GIT	MA	ELI	AI
	VE		.75	.70	GIT		.60	.55	.54
Total	AR	.73		.64	MA	.57		.59	.56
Sample	GIT	.68	.62		ELI	.53	.53		.57
					AI	.52	.57	.56	
		VE	AR	GIT		GIT	MA	ELI	AI
					GIT		.55	.56	.61
	VE		.76	.68	MA	.29		.57	.60
Low	AR	.33		.63	ELI	.28	.43		.63
Ability	GIT	.40	.28		AI	.28	.32	.39	
		VE	AR	GIT		GIT	MA	ELI	AI
					GIT		.60	.56	.54
	VE		.73	.70	MA	.33		.57	.57
Average	AR	.46		.64	ELI	.30	.34		.58
Ability	GIT	.45	.33		AI	.34	.39	.42	
		VE	AR	GIT		GIT	MA	ELI	AI
					GIT		.67	.67	.59
	VE		.78	.71	MA	.30		.77	.64
High	AR	.46		.67	ELI	.31	.35		.67
Ability	GIT	.40	.28		AI	.38	.39	.44	

[a] Observed correlation coefficients are shown below the diagonal, adjusted coefficients above the diagonal.

Table 3

CORRELATION BETWEEN ACADEMIC AND MECHANICAL CLUSTERS GROUPED BY LEVEL OF MENTAL ABILITY

		Academic Cluster						Academic Cluster					
		Observed Correlation			Equated Correlation			Observed Correlation			Equated Correlation		
		Total Sample						Low Ability					
		VE	AR	GIT	VE	AR	GIT	VE	AR	GIT	VE	AR	GIT
Mechanical Cluster	GIT	.68	.62		.70	.64		.40	.28		.68	.63	
	MA	.56	.56	.57	.58	.59	.60	.17	.22	.30	.54	.55	.55
	ELI	.49	.46	.53	.52	.49	.55	.19	.16	.31	.58	.55	.56
	AI	.37	.37	.52	.40	.40	.54	.14	.14	.38	.53	.54	.61
		Average Ability						High Ability					
Mechanical Cluster	GIT	.45	.33		.70	.64		.40	.28		.71	.67	
	MA	.21	.20	.33	.54	.54	.60	.30	.28	.29	.70	.71	.67
	ELI	.16	.11	.30	.49	.47	.56	.23	.19	.28	.68	.67	.67
	AI	.01	.02	.34	.34	.36	.54	-.01	-.01	.28	.46	.48	.59

Table 4

CORRELATION OF PATTERN ANALYSIS WITH ACB TESTS BY LEVEL OF MENTAL ABILITY

	Observed Correlation Coefficients				Equated Correlation Coefficients			
		Ability Level				Ability Level		
	Total Sample	High	Average	Low	Total Sample	High	Average	Low
VE	.52	.23	.08	-.10	.56	.70	.51	.50
AR	.57	.37	.18	-.03	.60	.77	.58	.56
ACS	.36	.22	.19	.06	.39	.50	.46	.47
ARC	.41	.20	.16	.07	.44	.49	.40	.39
GIT	.48	.20	.11	-.03	.51	.65	.51	.42
MA	.55	.34	.25	.13	.58	.75	.56	.49
ELI	.45	.27	.17	.02	.48	.73	.49	.42
AI	.36	.10	.11	-.02	.39	.56	.40	.40
SM	.49	.26	.18	.20	.52	.74	.49	.61

Table 5

CLUSTERS OF ACB TESTS BY LEVEL OF EDUCATION

Academic Cluster				Mechanical Cluster				
High School Graduates				High School Graduates				
	VE	AR	GIT		GIT	MA	ELI	AI
				GIT		.59	.55	.54
VE		.74[a]	.69	MA	.56		.61	.57
AR	.71[a]		.62	ELI	.52	.59		.68
GIT	.66	.59		AI	.51	.54	.56	
Non-High School Graduates				Non-High School Graduates				
	VE	AR	GIT		GIT	MA	ELI	AI
				GIT		.56	.52	.58
VE		.69	.68	MA	.44		.54	.57
AR	.56		.61	ELI	.42	.44		.57
GIT	.57	.48		AI	.48	.48	.50	

[a] Observed correlation coefficients are shown below the diagonal, squared coefficients above the diagonal.

Table 6

CLUSTERS OF ACB TESTS BY RACIAL GROUP

Academic Cluster				Mechanical Cluster				
	Negro				Negro			
	VE	AR	GIT		GIT	MA	ELI	AI
				GIT		.50	.49	.45
VE		.77[a]	.63	MA	.29		.49	.41
AR	.51[a]		.58	ELI	.31	.32		.47
GIT	.41	.32		AI	.35	.30	.37	
	White				White			
	VE	AR	GIT		GIT	MA	ELI	AI
				GIT		.57	.53	.51
VE		.74	.70	MA	.54		.58	.53
AR	.71		.63	ELI	.49	.55		.55
GIT	.67	.60		AI	.48	.51	.53	

[a] Observed correlation coefficients are shown below the diagonal, adjusted coefficients above the diagonal.

The observed correlation coefficients were lower for the Negro men than for the white men, but race is a complicated variable, and the result observed for the racial groups as a whole may actually be confounded with other variables. To reduce some of the effects of confounding, intercorrelations were also obtained for the cross-classifications of race with education and of race with general ability.

Racial Group by Level of Education

The intercorrelations of the academic tests for the subgroups of the race-by-education classification were in the same direction as those for racial group and education taken separately (Table 7). The observe correlation coefficients were highest for the white graduates and lowest for the Negro nongraduates; those for the white nongraduates and Negro graduates were at about the same level, intermediate to the other subgroups. PA and MA were part of the academic cluster for three subgroups, Negro graduates, white graduates, and white nongraduates, but not for the Negro nongraduates, as shown in Tables A-8 through A-11 of the Appendix.

Racial Group by General Ability Level

One of the socially significant questions is whether the usual type of paper-and-pencil test provides meaningful measurement for members of disadvantaged groups. Negro men of low mental ability clearly fit into the category as being part of a disadvantaged subculture. The question studied here was whether the tests of the ACB show the same consistency of measurement for Negro men of low ability as they do for other groups. Correlation among the tests in the academic cluster and in the mechanical cluster is shown in Table 8. Only the average and low levels of general ability were included because of the small N in the high ability Negro sample.

The observed coefficients for the academic cluster followed the pattern observed before: Intercorrelations were highest (.3[illegible] - .4[illegible]) for the whites of average ability and lowest (.1[illegible] - .3[illegible]) for the Negroes of low ability. The equated coefficients for the academic cluster showed a different pattern, being highest for Negro men of low ability.

Based on the observed correlation coefficients, the mechanical cluster was least well defined for the Negro men of low ability, and about equally well defined for the other three groups. Based on the equated coefficients, in contrast, the mechanical cluster was best defined for the Negro men of low ability and most poorly defined for white men of low ability.

The relationships between the academic and mechanical clusters are shown in Table 9. The lowest observed coefficients were for the Negro men of low ability. As found for the three level of general ability, AI was also virtually independent of academic tests VE and AR when both race and general ability were taken into account. In the equated correlation

Table 7

CLUSTERS OF ACB TESTS BY RACE AND EDUCATION

		Non-High School Graduates								High School Graduates							
		Negro				White				Negro				White			
			VE	AR	GIT		VE	AR	GIT		VE	AR	GIT		VE	AR	GIT
Academic Tests	VE			.76[a]	.55			.68	.68			.77	.67			.72	.66
	AR	.41[a]			.52	.57			.60	.55			.61	.67			.58
	GIT	.31	.25			.59	.49			.47	.36			.61	.53		
		GIT	MA	ELI	AI	GIT	MA	ELI	AI	GIT	MA	ELI	AI	GIT	MA	ELI	AI
Mechanical Tests	GIT		.40	.41	.42		.54	.51	.55		.54	.53	.47		.56	.52	.49
	MA	.22		.42	.34	.44		.52	.56	.34		.53	.45	.50		.60	.53
	ELI	.25	.27		.41	.41	.49		.56	.36	.36		.50	.46	.55		.55
	AI	.34	.25	.34		.47	.48	.49		.35	.33	.40		.44	.49	.52	

[a] Observed correlation coefficients are shown below the diagonal, equated coefficients above the diagonal.

Table 8

CLUSTERS OF ACB TESTS BY RACE AND GENERAL ABILITY

	Low Ability						Average Ability					
A. Academic Tests	Negro			White			Negro			White		
	VE	AR	GIT	VE	AR	GIT	VE	AR	GIT	VE	AR	GIT
VE		.88[a]	.77		.67	.60		.70	.60		.73	.69
AR	.23[a]		.73	.36		.54	.43		.60	.46		.62
GIT	.29	.15		.44	.31		.31	.28		.45	.32	
B. Mechanical Tests												
	GIT	MA	ELI	AI	CIT	MA	ELI	AI	GIT	MA	ELI	AI	GIT	MA	ELI	AI
GIT		.65	.67	.63		.43	.44	.51		.60	.59	.59		.56	.52	.48
MA	.18		.68	.61	.31		.44	.50	.32		.59	.55	.30		.54	.52
ELI	.24	.26		.64	.31	.34		.54	.33	.30		.60	.27	.33		.54
AI	.31	.26	.34		.37	.40	.44		.38	.30	.40		.29	.37	.40	

[a] Observed correlation coefficients are shown below the diagonal, equated correlations above the diagonal.

coefficients, the two clusters were much less independent, and the correlational pattern was different. For Negro men of low ability, the two clusters were most closely related when the equated correlation coefficients were considered and least related when the observed coefficients were considered. The distinction between the clusters was in part a function of the amount of restriction placed on the samples.

Trends of Specific Tests

When the tests were examined across all subgroups, the test that had the most stable correlation with all other tests in the battery was GIT. It had among the highest correlation coefficients across both the academic cluster and the mechanical cluster for all groups. GIT taps knowledge and skills that can be learned in school, through personal reading, or through practical experience. The content is not bound to a particular curriculum or subculture. The items are broadly classified into four major categories: Team Sports, Individual Sports, Hobbies and Pastimes, and Military Information (10). If the criterion-related validity is also high for all subgroups, then GIT can serve as a useful measure of general mental ability for all groups. Its validity in comparison to VE and AR, which are more purely academic measures of ability, will be a good test of its usefulness.

Three of the ACB tests ACS, ARC, and PA, are nonverbal; a fourth test, SM, is nonverbal for the low ability group. The Shop Mechanics Test administered to the low ability group is a component of the Army Qualification Battery used at Armed Forces Entrance and Examining Stations to screen men whose AFQT score is below 31 to determine whether they have special abilities of a level to qualify them for acceptance. The AQB/SM is a nonverbal test. In contrast, the ACB/SM administered to men above the 7 th percentile has a heavy verbal content. The correlation among the nonverbal tests is shown in Table 1). The observed coefficients were relatively low at all three ability levels; a nonverbal factor did not emerge for the low ability men. Nor did the equated coefficients indicate a stronger nonverbal factor for the low ability men. The pattern of mean scores was different for the three ability groups. ACS, a cognitively simple test, had the smallest difference, and PA, a complex test, the largest. Apparently, the nature of the nonverbal test, rather than nonverbal content per se, is the critical factor in the intercorrelations.

The nonverbal tests ACS, ARC and PA did exhibit different patterns of means in the various subgroups. ACS consistently had the smallest differences in means. Two other tests, ARC and PA, had large differences. SM was in-between. The correlation of ACS and ARC with VE and AR remained fairly constant across subgroups; in fact, the coefficients showed some of the smallest differences. PA, on the other hand, was almost completely independent of the other ACB tests, when the observed correlation coefficients were considered, for groups of lower ability.

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10 Green, C.G. Development of item pools for new combat selection tests. BESRL Research Memorandum [illegible], [illegible].

Table 9

CORRELATION BETWEEN ACADEMIC AND MECHANICAL CLUSTERS
BY RACE AND MENTAL ABILITY

		Negro Academic Cluster						White Academic Cluster					
		VE (Observed Corr	AR Corr	CIT Coeff)	VE (Equated Corr	AR Corr	CIT Coeff)	VE (Observed Corr	AR Corr	CIT Coeff)	VE (Equated Corr	AR Corr	CIT Coeff)
Low Ability	CIT	.39	.15		.77	.73		.44	.31		.60	.54	
Mechanical Cluster	MA	.08	.12	.16	.71	.72	.65	.19	.23	.31	.36	.42	.43
	EI	.14	.10	.24	.72	.70	.67	.20	.16	.31	.41	.40	.66
	AI	.04	.04	.31	.60	.59	.61	.16	.14	.38	.41	.41	.51
		VE (Observed Corr	AR Corr	CIT Coeff)	VE (Equated Corr	AR Corr	CIT Coeff)	VE (Observed Corr	AR Corr	CIT Coeff)	VE (Equated Corr	AR Corr	CIT Coeff)
Average Ability	CIT	.31	.29		.60	.60		.45	.32		.69	.62	
Mechanical Cluster	MA	.20	.24	.32	.55	.56	.60	.19	.19	.30	.52	.52	.54
	EI	.20	.24	.31	.54	.55	.59	.16	.09	.27	.46	.44	.52
	AI	.04	.04	.34	.49	.41	.54	-.01	-.01	.29	.29	.30	.49

Table 10

INTERCORRELATIONS* AMONG UNIVERSAL TESTS
BY LEVEL OF MENTAL ABILITY

	Low Ability					Average Ability					High Ability				
	MEAS	SM	PA	ACS	ARC	MEAS	SM	PA	ACS	ARC	MEAS	SM	PA	ACS	ARC
SM	90.9		.41	.44	.31	100.0		.49	.38	.29	115.0		.34	.42	.40
PA	91.0	.20		.41	.19	100.2	.14		.44	.40	121.9	.14		.30	.44
ACS	93.5	-.01	.14		.31	102.0	.11	.19		.44	111.0	.07	.22		.44
ARC	94.5	-.04	.07	.30		97.7	.04	.16	.38		112.0	.05	.20	.27	

*

**

The three perceptual tests, ACS, ARC and PA, differ in the complexity and familiarity of the tasks. ACS has the simplest and most familiar tasks. The examinee must examine digits and word-digit combinations which involve familiar symbols. The task involves simple digit inversions or location of the number that goes with a word. ARC is cognitively simple, but unfamiliar. The examinee is exposed to Morse Code signals, which are unfamiliar to most persons. The discriminations between the patterns of dots and dashes are simple enough, though, when the proper training has been undergone. Of these tests PA is probably the most complex and least familiar to individuals outside the dominant educational values and curriculum. The individuals who are outside the educational mainstream--Negroes, nongraduates, and men of low ability--did less well on PA and ARC.

The greatest difference among the subgroups was on VE and AR. These tests are the most complex in that they require the ability to deal with abstract symbols. The capacity to handle numbers and words, plus the ability to learn unfamiliar tasks quickly and easily, is highly valued by the dominant U. S. culture. Thus, it is on tests of the abilities valued most highly in the main culture that those outside the cultural mainstream show the greatest disparity.

The Classification Inventory (CI) is a noncognitive measure, and as such does not measure aptitudes directly. Its observed correlation pattern showed some large racial differences. For whites of all educational levels, it was moderately correlated with all other ACB tests, most of the observed coefficients being in the .[illegible]'s and .[illegible]'s. When mental ability and race were both taken into account, the observed correlation coefficients were highest for Negro men of average ability, and lowest for Negro men of low ability (Table II). The equated coefficients were highest for Negro men of low ability.

IMPLICATIONS OF THE RESULTS

The results presented in the tables demonstrate the difficulty of drawing accurate conclusions about the effectiveness of aptitude tests for minority groups. One result remained invariant--the emergence of the academic and mechanical clusters of tests. These clusters were found for all groups, in both the observed and equated coefficients, but definiteness of the clusters depended on the set of coefficients considered. The correlational values for Negro men of low ability especially seemed to be affected by equating all groups for restriction on the general ability measure, AFQT. The difficulties arose because the groups were subject to varying degrees of restriction in range, and the correlation coefficients were differentially affected.

The observed correlation among the ACB tests for the various groups could not be interpreted unambiguously because the variables were subject varying degrees of incidental selection. As is well known, correlation

Table 11

CORRELATION OF CI WITH THE OTHER ACB TESTS

	Observed Correlation Coefficients				Equated Correlation Coefficients			
	Negro		White		Negro		White	
	Low	Average	Low	Average	Low	Average	Low	Average
VE	.13	.27	.24	.25	.59	.51	.40	.45
AR	.08	.27	.16	.20	.57	.52	.36	.42
ACS	.16	.30	.21	.21	.53	.47	.35	.37
ARC	.05	.16	.05	.10	.47	.33	.14	.26
GIT	.24	.28	.24	.30	.58	.50	.36	.48
MA	.07	.33	.17	.22	.49	.54	.27	.40
ELI	.12	.16	.17	.16	.51	.42	.29	.35
AI	.11	.20	.17	.11	.44	.42	.30	.27
SM	.11	.24	.09	.18	.54	.48	.28	.36
PA	.01	.12	.05	.05	.54	.43	.23	.31

among incidentally selected variables is a biased estimate of the population value (11), and hence does not describe the true relationship. The regression of one incidentally selected variable on another is also a biased estimate of the population value. The observed regression line in a bivariate distribution subjected to incidental selection will ordinarily be curvilinear, even though the population relationship is linear. The slope will be affected by the extent of the curvilinearity arising from the effects of incidental selection. Thus, neither the correlation coefficients nor the regression slopes for the incidental variable remain invariant under selection[2].

The lack of invariance of the slopes has strong implications for comparing the effectiveness of tests for Negroes and whites in predicting external criteria such as training or job performance. Evaluations of training and job performance are also subject to incidental selection just as test scores are. The exact nature and extent is impossible to specify at the present time with our limited knowledge of cultural effects and opportunities. In unselected populations of whites and Negroes, regression of an external criterion on test scores may be the same or different, but because incidental selection is operating to an unknown degree, the true effects of race are extremely difficult to determine. Lord in 1969 (12) addressed the same problem when he argued that the analysis of covariance is inappropriate for comparing preexisting groups.

The above arguments about the artifactual values of the correlation and regression coefficients are the technical side of the more general caveat about comparing social groups. Social groups differ along many dimensions, and only a small number of the dimensions can be included in any research design. Generalizations are limited, as in any research, to the particular populations and variables involved. This fact is obvious and usually no attention needs to be drawn to it. But when dealing with socially sensitive issues, the obvious sometimes gets overlooked and unwarranted generalizations are made. No general conclusions can be drawn about the overall aptitude differences between Negroes and whites on the basis of the present analysis. Generalizations are limited to Negro and white men who were in the Army and to the paper-and-pencil type of aptitude measures.

Given the limitations of the populations and of the measuring instruments employed, what conclusions can legitimately be drawn? First and foremost, the ACB tests do function in the expected manner for all subgroups. The academic and mechanical clusters were always found, a result which supports the construct validity of the tests. There were enough differences among the tests and the groups, however, to warrant an extensive research program to find out what differences exist and what

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[2] This relationship was pointed out to the author by Dr. John Mellinger.

[11] Gulliksen, H. Theory of Mental Tests. New York: Wiley, 1950.

[12] Lord, F.M. Statistical adjustment when comparing preexisting groups. Psychological Bulletin. 1969, 72, 336-337.

impact these have on the Army's selection-classification-training-utilization system.

A second conclusion is that the nonverbal tests did not form a separate cluster; rather, test content was more important in the placement of nonverbal tests in the academic or the mechanical cluster. SM was in the mechanical cluster, and the other nonverbal tests, ARC, ACS, and PA, were more closely related to the academic tests.

The next step is to examine the validity of the ACB tests in predicting external criteria. How does the validity of the academic tests compare with that of the mechanical tests? Do the perceptual tests differ in their predictive validity of Negroes and whites in the Army? As a large body of facts is found, stable patterns may emerge and these can then be included in formulating a more rational and an equitable personnel system.

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APPENDIXES

Appendix

Page

A. ACB test means and standard deviations of total sample and subgroups by ability level, by education level, and by racial group 30

B. Observed intercorrelation of ACB tests in subgroups of enlisted sample 33

Table A-1

MEANS OF AFQT AND ACB BY LEVEL OF MENTAL ABILITY, LEVEL OF EDUCATION, AND RACIAL GROUP

Test		Total Sample	General Mental Ability			Level of Education		Racial Group	
			Low	Average	High	Non H.S. Grad	H.S. Grad	Negro	White
AFQT		68.8	17.8	68.9	83.2	34.5	57.0	23.6	52.7
ACB									
Verbal	(VE)	103.2	80.1	105.2	124.1	89.8	110.8	84.9	106.1
Arith. Reas.	(AR)	99.6	77.6	100.7	120.6	86.2	106.9	80.3	102.5
Clerical	(ACS)	103.8	95.3	102.6	113.8	96.2	107.7	93.9	105.2
Radio Code	(ARC)	96.2	78.3	97.7	112.6	84.9	102.5	79.3	98.7
Gen. Info.	(GIT)	99.0	82.5	100.0	114.5	90.0	106.1	81.7	101.7
Mech. Apt.	(MA)	102.7	88.6	101.9	119.0	93.6	108.9	86.2	105.3
Elect. Info.	(ELI)	101.0	88.6	98.6	116.8	94.7	104.5	85.8	103.3
Auto. Info.	(AI)	103.6	92.0	103.6	115.1	99.2	105.8	87.9	105.8
Shop Mech.	(SM)	102.1	90.9	100.6	115.6	97.9	104.5	87.2	104.6
Spatial	(PA)	101.1	81.8	100.2	121.9	92.2	108.0	85.3	103.6
Classif. Inv.	(CI)	94.6	85.6	94.2	104.9	89.1	98.3	88.1	96.8
	N	17,729	5,396	7,071	5,262	6,300	11,292	2,310	15,282

Test		Race and General Ability						Race and Education			
		Low		Average		High		Non Graduates		Graduates	
		Negro	White	Negro	White	Negro	White	Negro	White	Negro	White
AFQT		16.3	19.5	60.5	67.3	78.7	83.2	27.3	36.9	74.6	81.1
ACB											
Verbal	(VE)	78.5	81.0	99.9	105.7	114.6	124.2	81.9	91.4	99.8	111.9
Arith. Reas.	(AR)	74.8	78.9	96.5	101.3	112.5	120.6	78.1	88.3	97.4	110.0
Clerical	(ACS)	92.3	96.9	97.6	103.0	104.2	113.9	92.0	97.6	95.4	109.2
Radio Code	(ARC)	74.6	80.1	92.0	98.2	105.2	112.4	77.1	86.4	91.5	105.2
Gen. Info.	(GIT)	78.9	84.4	89.2	101.0	101.7	114.8	80.7	91.8	92.5	106.9
Mech. Apt.	(MA)	83.7	90.5	92.2	102.5	103.8	119.1	85.9	97.2	98.4	109.3
Elect. Info.	(ELI)	83.7	90.8	90.2	99.4	109.5	116.9	85.9	96.5	85.8	106.9
Auto. Info.	(AI)	88.8	94.3	90.6	104.6	98.1	115.3	88.2	101.4	87.7	106.1
Shop Mech.	(SM)	85.3	93.6	91.6	101.4	103.7	115.7	88.7	99.8	88.1	106.6
Spatial	(PA)	80.9	82.1	98.6	100.5	115.5	122.0	85.8	91.5	91.2	108.7
Classif. Inv.	(CI)	85.8	85.9	88.4	91.7	101.1	105.6	88.8	89.8	85.7	97.8
	N	1,441	3,855	588	6,483	61	5,201	1,025	5,275	1,285	10,007

Table A-2

STANDARD DEVIATIONS OF AFQT AND ACB BY LEVEL OF MENTAL ABILITY, LEVEL OF EDUCATION, AND RACIAL GROUP

Test		Total Sample	General Mental Ability			Level of Education		Racial Group	
			Low	Average	High	Non-H.S. Grad	H.S. Grad	Negro	White
A. Groups not equated on AFQT variability									
AFQT		27.0	9.1	11.3	8.6	21.1	26.6	14.6	26.4
ACB									
Verbal	(VE)	23.5	16.7	17.1	14.0	19.8	22.0	18.7	22.8
Arith. Reas.	(AR)	23.0	16.3	16.4	14.8	19.1	21.8	17.7	22.3
Clerical	(ACS)	18.8	17.3	18.5	15.9	17.8	18.2	17.5	18.5
Radio Code	(ARC)	27.7	24.1	25.6	22.9	25.7	26.8	26.0	27.1
Gen. Info.	(GIT)	19.6	17.2	14.8	13.5	18.0	18.6	16.6	18.7
Mech. Apt.	(MA)	19.5	15.4	15.5	15.5	17.0	19.6	15.0	18.9
Elect. Info.	(ELI)	20.7	17.7	18.6	15.5	19.2	20.7	17.9	20.1
Auto. Info.	(AI)	19.2	17.0	17.2	16.6	18.2	19.3	15.8	18.5
Shop Mech.	(SM)	18.0	16.1	15.2	14.3	16.3	18.5	15.2	17.3
Spatial	(PA)	22.7	17.4	17.5	13.9	20.4	22.4	18.1	22.4
Classif. Inv.	(CI)	22.5	17.2	22.8	22.5	20.1	23.4	18.7	22.8
B. Groups equated on AFQT variability									
AFQT		28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8
ACB									
Verbal	(VE)	24.5	26.7	23.8	21.0	23.5	23.0	27.5	24.0
Arith. Reas.	(AR)	24.0	27.9	23.4	23.3	22.6	22.8	25.8	23.5
Clerical	(ACS)	19.0	22.2	21.4	18.0	18.3	18.5	18.8	18.8
Radio Code	(ARC)	28.2	27.7	28.5	26.0	27.2	27.3	30.5	27.7
Gen. Info.	(GIT)	20.2	22.0	19.6	18.9	20.3	19.3	19.9	19.4
Mech. Apt.	(MA)	20.1	19.0	19.5	24.3	19.0	20.3	17.7	19.6
Elect. Info.	(ELI)	21.2	21.8	22.5	24.6	20.8	21.3	20.4	20.7
Auto. Info.	(AI)	19.5	21.1	19.6	21.3	19.8	19.7	16.7	18.9
Shop Mech.	(SM)	18.4	23.4	18.5	23.5	17.7	19.1	17.5	17.8
Spatial	(PA)	23.5	24.5	23.8	24.1	23.6	23.5	24.6	23.5
Classif. Inv.	(CI)	22.7	19.0	25.3	25.8	20.6	23.7	19.2	23.1
	N	17,729	5,396	7,071	5,262	6,300	11,292	2,310	15,282

Table A-3

STANDARD DEVIATIONS OF AFQT AND ACB BY RACE, BY LEVEL OF EDUCATION, AND BY MENTAL ABILITY

Test		Race and Education				Race and General Mental Ability					
		Non Graduates		Graduates		Low		Average		High	
		Negro	White	Negro	White	Negro	White	Negro	White	Negro	White
A. Groups not equated on AFQT variability											
AFQT		12.4	21.6	16.1	24.8	5.5	6.2	9.7	11.2	7.6	8.6
ACB											
Verbal	(VE)	16.8	20.0	19.8	20.3	15.1	17.3	16.9	17.0	17.7	13.9
Arith. Reas.	(AR)	16.2	19.1	18.5	20.1	14.8	16.7	15.1	16.3	14.8	14.8
Clerical	(ACS)	17.3	17.7	17.5	17.7	16.9	17.3	18.6	18.4	15.2	15.8
Radio Code	(ARC)	24.4	25.7	27.1	25.5	23.7	24.0	27.0	25.4	26.7	22.9
Gen. Info.	(GIT)	16.2	17.8	16.9	17.0	16.2	17.4	14.3	14.4	15.5	13.4
Mech. Apt.	(MA)	14.3	16.9	15.5	18.5	14.4	15.4	13.9	15.3	16.2	15.5
Elect. Info.	(ELI)	17.2	19.1	18.5	19.7	16.4	17.7	19.9	18.3	19.9	15.5
Auto. Info.	(AI)	15.8	17.9	15.8	18.4	16.0	16.9	14.7	16.9	15.9	16.6
Shop Mech.	(SM)	14.7	16.0	15.5	17.4	14.7	16.1	15.0	14.9	16.4	14.3
Spatial	(PA)	17.6	20.7	18.4	21.4	15.9	18.0	17.2	17.5	14.0	13.9
Classif. Inv.	(CI)	18.5	20.4	18.8	23.6	17.0	17.3	22.3	22.9	20.4	22.5
B. Groups equated on AFQT variability											
AFQT		28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8
ACB											
Verbal	(VE)	26.2	23.4	27.8	21.8	38.5	23.3	23.0	23.5	22.0	21.0
Arith. Reas.	(AR)	25.4	22.3	25.8	21.7	35.8	24.7	21.3	23.2	19.4	23.3
Clerical	(ACS)	18.6	18.2	18.7	18.0	25.5	20.2	21.2	21.2	15.2	18.0
Radio Code	(ARC)	27.9	27.0	31.7	26.2	35.3	24.9	29.6	28.3	27.0	26.0
Gen. Info.	(GIT)	18.7	19.8	20.3	18.0	24.8	19.7	18.4	18.7	16.2	18.8
Mech. Apt.	(MA)	16.2	18.6	18.5	19.6	22.1	16.5	18.4	18.9	26.6	24.1
Elect. Info.	(ELI)	19.2	20.5	21.1	20.7	24.4	19.4	25.6	21.8	39.4	24.4
Auto. Info.	(AI)	16.4	19.2	16.9	19.0	20.5	18.9	17.6	18.7	19.2	21.1
Shop Mech.	(SM)	16.7	17.2	17.9	18.4	26.1	20.2	19.4	17.7	21.4	23.4
Spatial	(PA)	25.1	23.6	24.5	23.3	35.1	21.7	24.4	23.8	23.4	24.1
Classif. Inv.	(CI)	18.7	20.9	19.6	24.1	21.2	18.4	25.8	25.1	22.5	25.9
	N	1,025	5,275	1,285	10,007	1,681	3,644	588	6,437	41	5,201

APPENDIX B OBSERVED INTERCORRELATION OF ACB TESTS IN SUBGROUPS OF ENLISTED SAMPLE

List of Intercorrelation Matrixes

B-1. General Mental Ability--Low

B-2. General Mental Ability--Average

B-3. General Mental Ability--High

B-4. Education--Non-High School Graduates

B-5. Education--High School Graduates

B-6. Racial Group--Negro

B-7. Racial Group--White

B-8. Non-High School Graduates--Negro

B-9. Non-High School Graduates--White

B-10. High School Graduates--Negro

B-11. High School Graduates--White

B-12. Low Mental Ability--Negro

B-13. Low Mental Ability--White

B-14. Average Mental Ability--Negro

B-15. Average Mental Ability--White

B-1

Matrix 1
GENERAL MENTAL ABILITY--LOW

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		33	26	24	40	17	19	14	-12	-10	21
AR	33		31	23	28	22	16	14	-11	03	14
ACS	26	31		30	25	16	13	08	-03	06	19
ARC	24	23	30		19	19	09	04	-04	07	05
GIT	40	28	25	19		30	31	38	10	-03	24
MA	17	22	16	19	30		35	39	27	13	14
ELI	19	16	13	09	31	35		44	26	02	15
AI	14	14	08	04	38	39	44		35	02	15
SM	-12	-11	-03	-04	10	27	26	35		20	10
PA	-10	03	06	07	-03	13	02	02	20		04
CI	21	14	19	05	24	14	15	15	10	04	

B-2

Matrix 2
GENERAL MENTAL ABILITY--AVERAGE

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		46	29	28	45	21	16	01	10	08	26
AR	46		40	26	33	20	11	02	06	18	21
ACS	29	40		28	22	21	09	02	13	19	22
ARC	28	26	28		21	18	05	01	04	16	11
GIT	45	33	22	21		33	30	34	29	11	31
MA	21	20	21	18	33		34	39	42	25	23
ELI	16	11	09	05	30	34		42	37	17	17
AI	01	02	02	01	34	39	42		50	11	13
SM	10	06	13	04	29	42	37	50		18	20
PA	08	18	19	16	11	25	17	11	18		06
CI	26	21	22	11	31	23	17	13	20	06	

B-3

Matrix 3
GENERAL MENTAL ABILITY--HIGH

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		46	25	27	40	30	23	-01	13	23	21
AR	46		43	26	28	28	19	-01	17	37	18
ACS	25	43		27	14	16	04	09	08	22	17
ARC	27	26	27		18	20	10	00	05	20	11
GIT	40	28	14	18		29	28	28	27	20	27
MA	30	28	16	20	29		43	32	42	34	21
ELI	23	19	04	10	28	43		39	39	27	13
AI	-01	-01	09	00	28	32	39		43	10	04
SM	13	17	08	05	27	42	39	43		26	17
PA	23	37	22	20	20	34	27	10	26		13
CI	21	18	17	11	27	21	13	04	17	13	

B-4

Matrix 4
EDUCATION--NON-HIGH SCHOOL GRADUATES

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		56	30	36	57	41	37	35	23	30	27
AR	56		37	34	48	41	33	33	19	36	24
ACS	30	37		30	26	24	18	13	16	22	24
ARC	36	34	30		29	29	19	17	13	27	11
GIT	57	48	26	29		44	42	48	30	27	29
MA	41	41	24	29	44		44	48	43	36	24
ELI	37	33	18	19	42	44		50	38	25	22
AI	35	33	13	17	48	48	50		47	23	19
SM	23	19	16	13	30	43	38	47		34	22
PA	30	36	22	27	27	36	25	23	34		12
CI	27	24	24	11	29	24	22	19	22	12	

B-5

Matrix 5
EDUCATION--HIGH SCHOOL GRADUATES

	VE	AR	ACS	ARC	CIT	MA	ELI	AI	SM	PA	CI
VE		71	41	47	66	54	47	32	42	54	39
AR	71		50	47	59	55	45	33	44	59	36
ACS	41	50		38	35	34	25	15	24	35	29
ARC	47	47	38		41	39	28	21	27	40	23
CIT	66	59	35	41		57	52	51	51	49	42
MA	54	55	34	39	57		59	54	61	58	37
ELI	47	45	25	28	52	59		56	57	49	30
AI	32	33	15	21	51	54	56		60	38	24
SM	42	44	24	27	51	61	57	60		52	32
PA	54	59	35	40	49	58	49	38	52		30
CI	39	36	29	23	42	37	30	24	32	30	

B-6

Matrix 6
RACIAL GROUP--NEGRO

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		51	32	34	41	25	26	12	08	21	18
AR	51		31	32	32	28	22	12	05	25	16
ACS	32	31		25	24	19	15	06	04	19	22
ARC	34	32	25		23	23	11	-01	01	25	11
GIT	41	32	24	23		29	31	35	16	16	26
MA	25	28	19	23	29		32	30	27	27	16
ELI	26	22	15	11	31	32		37	28	22	15
AI	12	12	06	-01	35	30	37		37	08	15
SM	08	05	04	01	16	27	28	37		26	17
PA	21	25	19	25	16	27	22	08	26		07
CI	18	16	22	11	26	16	15	15	17	07	

B-7

Matrix 7
RACIAL GROUP--WHITE

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		71	42	49	67	53	45	31	36	51	38
AR	71		50	47	60	53	43	31	36	56	35
ACS	42	50		39	36	34	24	14	22	34	29
ARC	49	47	39		41	39	27	20	23	39	22
GIT	67	60	36	41		54	64	48	44	45	39
MA	53	53	34	39	54		55	51	55	53	35
ELI	45	43	24	27	64	55		53	50	43	29
AI	31	31	14	20	48	51	53		54	33	21
SM	36	36	22	23	44	55	50	54		46	29
PA	51	56	34	39	45	53	43	33	46		27
CI	38	35	29	22	39	35	29	21	29	27	

B-8

Matrix 8
NON-HIGH SCHOOL GRADUATES--NEGRO

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		41	25	27	31	15	21	07	-00	10	12
AR	41		25	21	25	17	19	06	-04	16	11
ACS	25	25		22	19	15	11	01	-02	17	15
ARC	27	21	22		13	17	10	-04	-03	18	07
GIT	31	25	19	13		22	25	34	11	07	23
MA	15	17	15	17	22		27	25	19	16	13
ELI	21	19	11	10	25	27		34	20	13	12
AI	07	06	01	-04	34	25	34		34	02	14
SM	-00	-04	-02	-03	11	19	20	34		22	15
PA	10	16	17	18	07	16	13	02	22		02
CI	12	11	15	07	23	13	12	14	15	02	

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Matrix 9
NON-HIGH SCHOOL GRADUATES--WHITE

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		57	29	36	59	41	37	35	22	31	29
AR	57		37	34	49	40	32	32	18	37	25
ACS	29	37		30	25	23	17	12	16	22	25
ARC	36	34	30		30	30	18	17	12	27	11
GIT	59	49	25	30		44	41	47	29	27	30
MA	41	40	23	30	44		44	48	42	37	25
ELI	37	32	17	18	41	44		49	38	25	23
AI	35	32	12	17	47	48	49		45	23	18
SM	22	18	16	12	29	42	38	45		33	22
PA	31	37	22	27	27	37	25	23	33		13
CI	29	25	25	11	30	25	23	18	22	13	

B-10

Matrix 10
HIGH SCHOOL GRADUATES--NEGRO

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		55	35	38	47	31	29	16	16	29	23
AR	55		35	37	36	35	25	17	13	32	21
ACS	35	35		26	28	22	17	10	11	21	28
ARC	38	37	26		30	27	12	01	05	30	14
GIT	47	36	28	30		34	36	35	21	24	28
MA	31	35	22	27	34		36	33	34	36	18
ELI	29	25	17	12	36	36		40	35	28	17
AI	16	17	10	01	35	33	40		40	13	15
SM	16	13	11	05	21	34	35	40		29	18
PA	29	32	21	30	24	36	28	13	29		11
CI	23	21	28	14	28	18	17	15	18	11	

B-11

Matrix 11
HIGH SCHOOL GRADUATES--WHITE

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		67	36	42	61	48	41	23	35	49	37
AR	67		46	40	53	49	39	24	36	55	34
ACS	36	46		34	29	29	19	07	18	30	26
ARC	42	40	34		34	33	22	14	20	34	21
GIT	61	53	29	34		50	46	45	45	43	40
MA	48	49	29	33	50		55	49	57	53	35
ELI	41	39	19	22	46	55		52	53	45	28
AI	23	24	07	14	45	49	52		56	32	20
SM	35	36	18	20	45	57	53	56		48	29
PA	49	55	30	34	43	53	45	32	48		28
CI	37	34	26	21	40	35	28	20	29	28	

B-12

Matrix 12
LOW MENTAL ABILITY--NEGRO

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		23	26	21	29	06	14	06	-14	-11	13
AR	23		24	16	15	12	14	06	-17	-06	08
ACS	26	24		22	22	12	10	02	-08	09	16
ARC	21	16	22		15	14	07	-05	-09	10	05
GIT	29	15	22	15		18	24	31	05	-01	24
MA	06	12	12	14	18		26	26	18	12	07
ELI	14	14	10	07	24	26		34	21	06	12
AI	06	06	02	-05	31	26	34		31	-04	11
SM	-14	-17	-08	-09	05	18	21	31		16	11
PA	-11	-06	09	10	-01	12	06	-04	16		01
CI	13	08	16	05	24	07	12	11	11	01	

B-13

Matrix 13
LOW MENTAL ABILITY--WHITE

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		36	26	24	44	19	20	16	-15	-11	24
AR	36		32	24	31	23	16	14	-13	-03	16
ACS	26	32		32	24	14	11	07	-05	03	21
ARC	24	24	32		19	18	07	04	-06	04	05
GIT	44	31	24	19		31	31	38	07	-05	24
MA	19	23	14	18	31		34	40	26	12	17
ELI	20	16	11	07	31	34		44	23	-01	17
AI	16	14	07	04	38	40	44		32	-03	17
SM	-15	-13	-05	-06	07	26	23	32		21	09
PA	-11	-03	03	04	-05	12	-01	-03	21		05
CI	24	16	21	05	24	17	17	17	09	05	

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Matrix 14
AVERAGE MENTAL ABILITY--NEGRO

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		43	34	20	31	20	20	04	15	09	27
AR	43		37	20	28	22	19	04	11	21	27
ACS	34	37		21	18	24	14	08	22	24	30
ARC	20	20	21		13	18	-01	-10	00	18	16
GIT	31	28	18	13		32	33	38	25	15	28
MA	20	22	24	18	32		30	30	32	29	33
ELI	20	19	14	-01	33	30		40	31	27	16
AI	04	04	08	-10	38	30	40		51	20	20
SM	15	11	22	00	25	32	31	51		24	24
PA	09	21	24	18	15	29	27	20	24		12
CI	27	27	30	16	28	33	16	20	24	12	

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Matrix 15
AVERAGE MENTAL ABILITY--WHITE

	VE	AR	ACS	ARC	GIT	MA	ELI	AI	SM	PA	CI
VE		46	28	28	45	19	14	-02	08	08	25
AR	46		40	26	32	18	09	-01	03	18	20
ACS	28	40		28	22	20	07	-01	11	18	21
ARC	28	26	28		21	17	05	00	03	16	10
GIT	45	32	22	21		30	27	30	26	10	30
MA	19	18	20	17	30		33	37	41	24	22
ELI	14	09	07	05	27	33		40	36	15	16
AI	-02	-01	-01	00	30	37	40		48	09	11
SM	08	03	11	03	26	41	36	48		16	18
PA	08	18	18	16	10	24	15	09	16		05
CI	25	20	21	10	30	22	16	11	18	05	